FY99 - Innovative Vacuum Electronics MURI

94GHz Slotted Sixth-Harmonic Gyrotron - UC-Davis

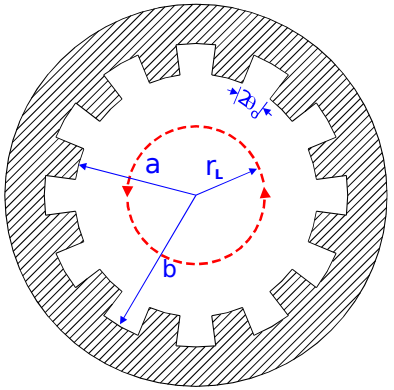
Objectives

Basic research to reduce magnetic fields needed by 94 GHz gyrotrons to make HPM devices lighter

Investigate concept of 25-100 kW W-band high harmonic gyrotron

Basis for high-harmonic gyro-amplifiers

12-Vane Slotted Circuit



Approach

Operation at s^{th}-harmonic reduces magnetic field by factor of *s*

Cusp gun produces needed axis-encircling electron beam

Slotted circuit enhances interaction

Accomplishments

Received two Northrop Cusp guns

94 GHz 6^{th}-harmonic gyrotron concep
- 50 kW with 20% efficiency
- Circuit has been fabricated

94 GHz 8^{th}-harmonic gyrotron concep
- Employs permanent magnet

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Photo-Electron Emission from Si Field Emitters - UC

Objectives

- Basic research on high speed optically gated field emission.

Investigate concepts for robust pulsed vacuum photo-cathode.

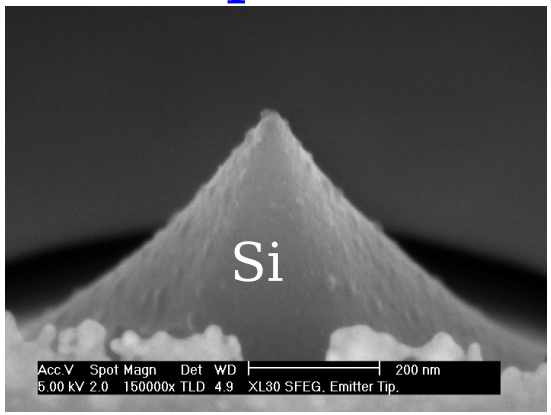
Approach

Fabricate Si field emitter arrays.

Subpicosecond optical excitation.

Characterize field penetration depth with doping level.

Ultrasharp Si Field Emitter T



Accomplishments

Fabricated 100 x 100 gated array.

15 nm tip radius with 1 micron gate radius.

Measured CW L-I curves.

MIT PHOTONIC BANDGAP CAVITY RESEARCH

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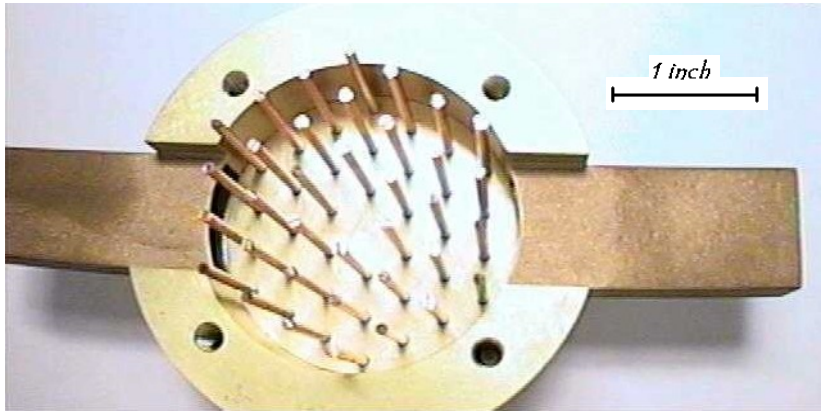
Started **1 May 99**

Massachusetts Institute of Technology
http://www.psfc.mit.edu/wab/personnel/temkin.html

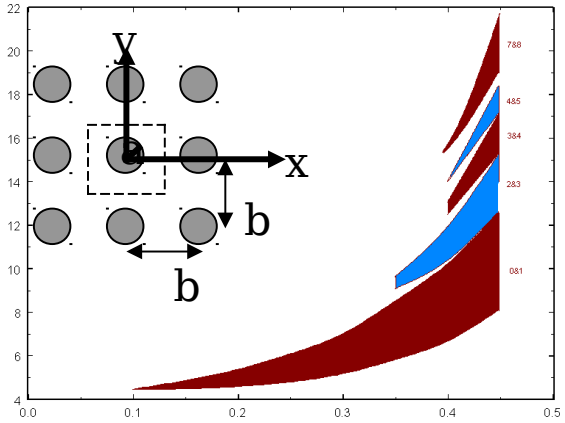
August, 2000



Photonic Bandgap Cavity

Accomplishments (Experiment)

- PBG cavity studied in cold test
- 17 GHz frequency, TM_{010} -like mode
- Triangular lattice of metal rods with a defect in the center
- Waveguide coupling, some rods removed or partially withdrawn for coupling



Lattice aspect ratio
(rod radius a)/(spacing b)

Accomplishments (Theory)

- PBGSS - Photonic Bandgap Structure Simulator - code developed for metal rod lattices
- Global bandgaps in square lattices determined

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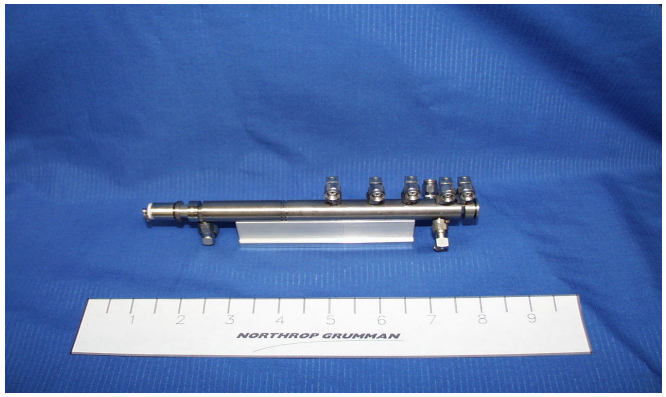
University of Wisconsin

Web URL:http://tempest.engr.ucdavis.edu/muri99/muri99.html

Started 1 August 99

Aug '99 - July '00



Custom-designed research TWT with unprecedented experimental access to detailed internal physics including a multiple-output-port circuit and spent beam diagnostic access

MURI Objectives

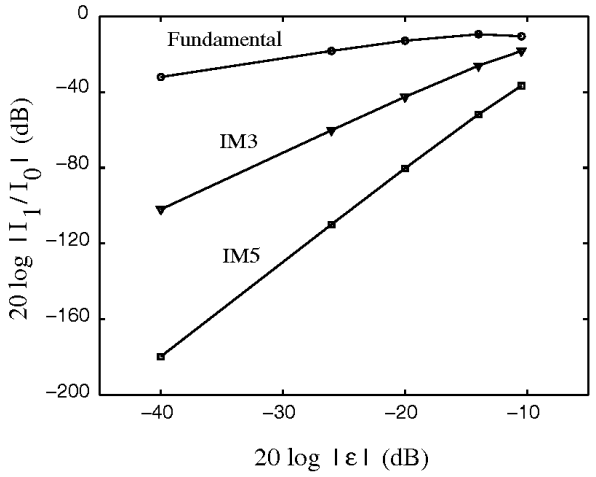
- Investigate traveling wave tube (TWT) performance for broadband amplification (including impulse & multitone) with high power, efficiency, and linearity (**impact: advanced ECM**)
- Identify physics for TWT amplification of digital high-data-rate signals with high efficiency and preserved signal integrity (**impact: high-speed wireless comm & datalinks**)

Scientific/technical approaches

- Establish state-of-the-art TWT research capabilities
- Establish fundamental understanding of nonlinear TWT physics
- Investigate strategies to maximize linearity at high efficiency
- Leverage capabilities with

Most Significant Accomplishments

- Successful creation of a unique fundamental research TWT device(w/ Northrop Grumman)
- Formulation of new TWT theoretical models (w/ U Michigan).



MURI Objectives

- Understand interference in DoD microwave sources
- Explore reduction of interference & noise

Scientific/technical approaches

- Theory: both analytic and computational techniques
- Experiment, signal

Accomplishments

- Breakthrough in klystron intermodulation theory
- UW Collaboration on TWT

UC Davis/Stanford Collaboration on High-Average-Power Modular W-band Klystrons

Klystron Research Program

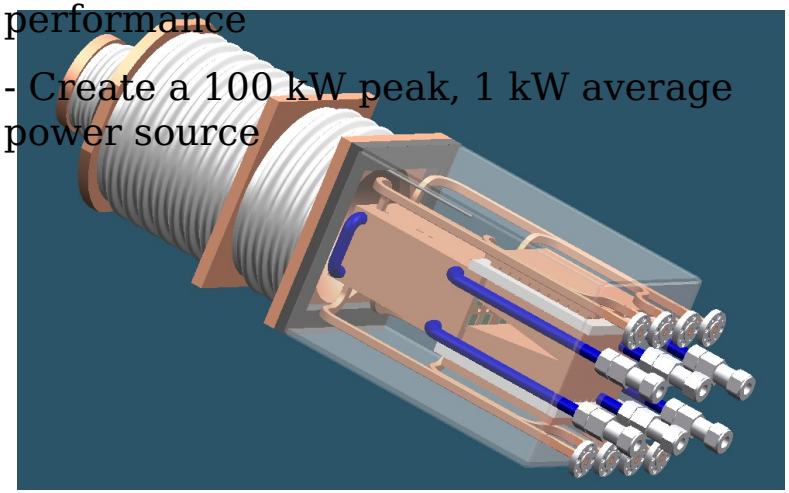
-Investigate high average power klystron at W-band

-Explore alternative fabrication methods to provide efficient, modular, and cost effective RF source

-Improve modeling of three dimensional RF circuit

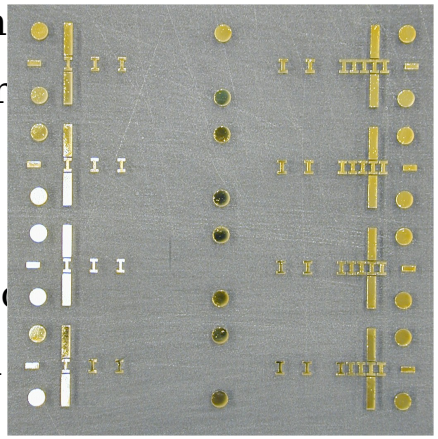
-Diagnose e-gun and beam transport performance

- Create a 100 kW peak, 1 kW average power source



Model of four klystrino module

Four “klystrinos” on
6 cm by 6 cm substr
Round posts are for
circuit alignment.
Short rectangular p
are for beam tunnel
alignment.



Six cavity klystrino circuit prior to electrodeposition

Project Status

LIGA fabrication of W-band cavities produced intrinsic Q’s near theoretical values

Beamstick with six cm PPM circuit produced >95% transmission

MAFIA and MAGIC used to produce accurate 2 D model of 3-D klystrino circuit

Machining of the electrodeposited LIGA klystrinos in progress